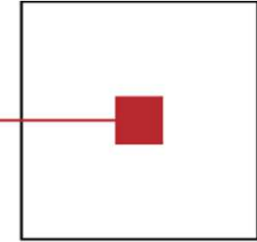




s c c h

software competence center  
hagenberg



# Continuous Database Monitoring with the Trace API

Firebird Conference 2011 – Luxembourg  
25.11.2011 – 26.11.2011

**Thomas Steinmaurer DI**

+43 7236 3343 896

thomas.steinmaurer@scch.at t.steinmaurer@upscene.com

www.scch.at

[www.upscene.com](http://www.upscene.com)

<http://blog.upscene.com/thomas/>

The SCCH is an initiative of

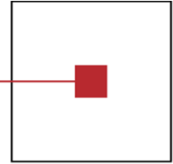


JOHANNES KEPLER  
UNIVERSITÄT LINZ

Netzwerk für Forschung, Lehre und Praxis

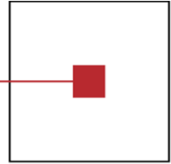
The SCCH is located at

softwarepark   
hagenberg

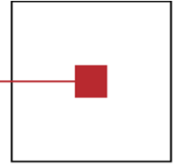


- **Motivation**
- Monitoring Approaches
- Firebird 2.5 Audit and Trace Services
- Usage of fbtracemgr
- FB TraceManager 2
- Q&A

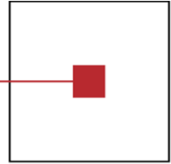




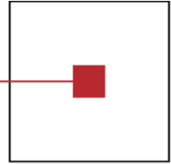
- Several stakeholders for database monitoring
  - Administrators
  - Developers
  - Auditors
  - ...
- A snapshot (MON\$) of current activities is interesting. But, most of the time you need the history of executed events
- Continuous monitoring gives you a stream of executed events over a period of time and lets you look back
- A new way to detect and diagnose problems
- The **Audit and Trace Services API in Firebird 2.5** provides that!!!



- Typical use cases for the **Audit and Trace Services API**
  - Number of executed statements for a particular time period
    - Usage statistics for load planning
  - Block-box debugging
    - Execution trace for an in-house / third-party product
    - For third-party products, usually you don't have access to the client source code
    - No need for adding trace logic into the client application
  - Detection of
    - Failed / Unauthorized access
    - Certain event types
    - Improper client transaction management (e.g. Regular usage of COMMIT RETAINING)
    - Full table scans

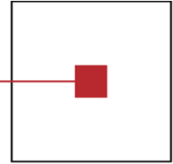


- Typical use cases for the **Audit and Trace Services API**
  - Detection of (continued)
    - Most-Frequently executed statements
    - Worst-Performing executed statements
    - Executed statements which are slower than a given threshold (e.g. 5 seconds)
  - Statistics
    - Number of statements per IP / process name / user ...
    - Most loaded database on the server
    - When are usual peak loads
    - ...
  - Generated trace as input for a security audit
  - **AND MORE ... !!!**



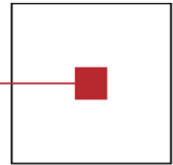
## Quick Start Demonstration





- Motivation
- **Monitoring Approaches**
- Firebird 2.5 Audit and Trace Services
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- FB TraceManager 2
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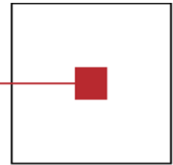




- Basic monitoring requirements
  - Continuous
  - Server-side
  - Configurable
- Three out-of-the box monitoring approaches in Firebird 2.5
  - Trigger-based (since Firebird 1.0)
  - Monitoring tables (since Firebird 2.1)
  - Audit and Trace Services (since Firebird 2.5)
- Based on your monitoring requirements, you possibly will have/use a mix of these approaches

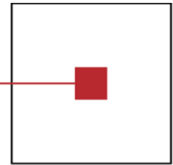


# Monitoring Approaches Comparison

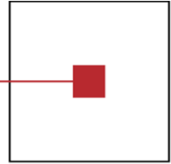


	Trigger-based	Monitoring tables	Audit/Trace Services
Available since Firebird version	1.0	2.1	2.5
Continuous	Yes	No	Yes
Serverside	Yes	Yes	Yes
Configurable	Yes	No	Yes
Monitoring of SELECT	No	Yes	Yes
Monitoring of DELETE, INSERT, UPDATE	Yes	Yes	Yes

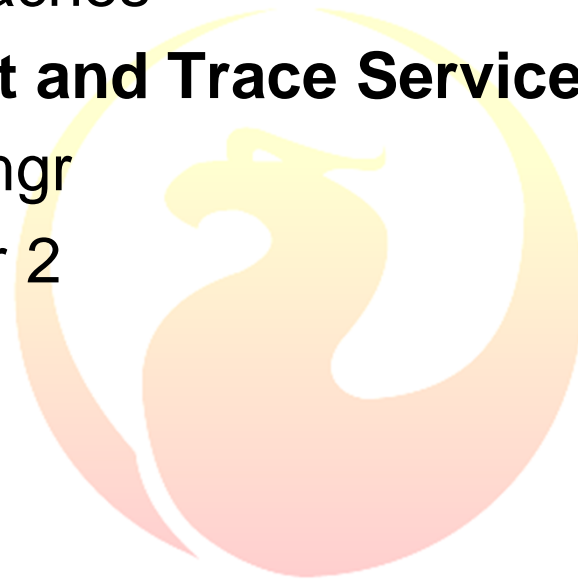
# Monitoring Approaches Comparison

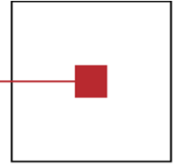


	Trigger-based	Monitoring tables	Audit/Trace Services
Access to old/new column values for DELETE, INSERT, UPDATE	Yes	No	No
Access to statement execution time	No	No	Yes
Access to statement execution plan	No	No	Yes
Monitoring of database-wide operations like connect, disconnect, transaction start etc.	Partly (database triggers in Firebird 2.1)	Partly	Yes



- Motivation
- Monitoring Approaches
- **Firebird 2.5 Audit and Trace Services**
- Usage of fbtracemgr
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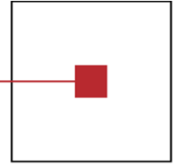




- New feature in Firebird 2.5 across all architectures and supported platforms
- Allows to produce a trace of events in chronological sequence
- Event types
  - Database-specific
    - Connect, Disconnect
    - Start/Commit/Rollback of transactions
    - Prepare/Start/Finish/Free of SQL statements
    - Start/Finish of stored procedures and triggers
    - etc.
  - Server-wide
    - Services API requests (e.g. backup, restore, get server log etc.)

# Audit and Trace Services

## System Audit vs. User Trace

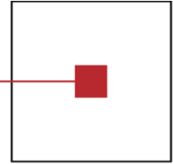


### ■ System Audit

- Will be started by the engine upon Firebird server start
- Stores trace output in a text file on the server
- Is activated by setting the new *AuditTraceConfigFile* parameter (= path to the trace configuration file) in *firebird.conf*
- There can be only one system audit per Firebird instance

### ■ User Trace

- Needs to be started by a user manually
- Trace output is read by the initiating application fetching trace data via the Services API
- Needs to be re-started after a server crash/restart
- There can be several user traces per Firebird instance



### ■ Implemented by the pre-installed fbtrace(.dll|.so) plugin

Trace session ID 1 started

```
2010-11-10T22:26:00.4160 (1368:0000000000F1DC88) TRACE_INIT  
SESSION_1 FBTM - tourism
```

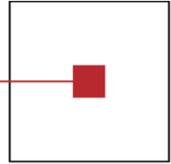
```
2010-11-10T22:26:00.4160 (1368:0000000000F1DC88) ATTACH_DATABASE  
tourism.fdb (ATT_1415, TOURISM:NONE, NONE, TCPv4:127.0.0.1)  
C:\Program Files (x86)\Upscene Productions\Database Workbench 4  
Pro\DBW4.exe:3768
```

```
2010-11-10T22:26:00.4220 (1368:0000000000F1DC88) START_TRANSACTION  
tourism.fdb (ATT_1415, TOURISM:NONE, NONE, TCPv4:127.0.0.1)  
C:\Program Files (x86)\Upscene Productions\Database Workbench 4  
Pro\DBW4.exe:3768  
(TRA_24395, READ_COMMITTED | REC_VERSION | NOWAIT | READ_WRITE)
```

```
2010-11-10T22:26:00.4860 (1368:0000000000F1DC88) PREPARE_STATEMENT  
tourism.fdb (ATT_1415, TOURISM:NONE, NONE, TCPv4:127.0.0.1)  
C:\Program Files (x86)\Upscene Productions\Database Workbench 4  
Pro\DBW4.exe:3768  
(TRA_24395, READ_COMMITTED | REC_VERSION | NOWAIT | READ_WRITE)
```

# Audit and Trace Services

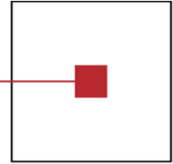
## Trace Configuration



- A system audit / user trace is configurable by providing a mandatory trace configuration (file)
- Customization of
  - Database-wide events
    - Connect, disconnect, prepare statement etc.
  - Server-wide events
    - Services API requests
- Consists of
  - Default <database> section
  - <database db\_name\_pattern> section per database
  - Max. one <services> section for server-wide events
- Pre-installed *fbtrace.conf* is a good start for writing your own trace configuration

# Audit and Trace Services

## Trace Configuration

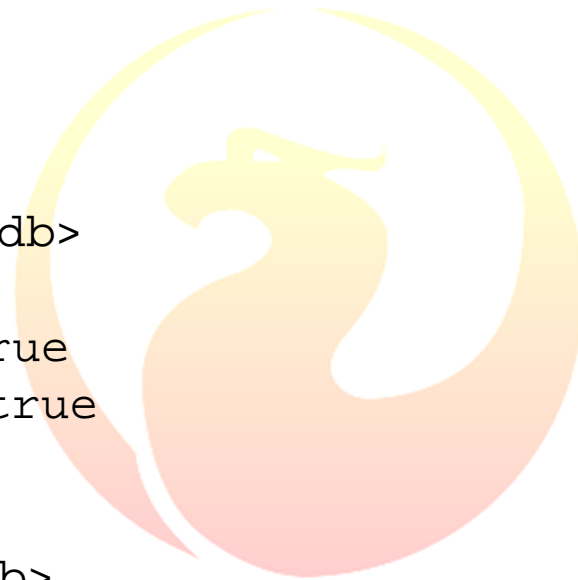


### ■ A very simple example

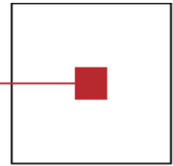
```
<database>  
  enabled true  
</database>
```

```
<database employee.fdb>  
  enabled false  
  log_connections true  
  log_transactions true  
</database>
```

```
<database tourism.fdb>  
  log_connections true  
</database>
```



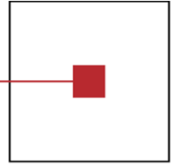




- <database> configuration parameters
  - enabled, log\_filename, max\_log\_size, include\_filter, exclude\_filter, log\_connections, connection\_id, log\_transactions, log\_statement\_prepare, log\_statement\_free, log\_statement\_start, log\_statement\_finish, log\_procedure\_start, log\_procedure\_finish, log\_trigger\_start, log\_trigger\_finish, log\_context, print\_plan, print\_perf, log\_blr\_requests, print\_blr, log\_dyn\_requests, print\_dyn, time\_threshold, max\_sql\_length, max\_blr\_length, max\_dyn\_length, max\_arg\_length, max\_arg\_count
- <services> configuration parameters
  - enabled, log\_filename, max\_log\_size, include\_filter, exclude\_filter, log\_services, log\_service\_query

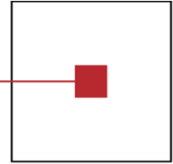
# Audit and Trace Services

## Manage Trace Sessions

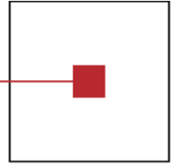


- Trace Sessions can be managed via new Services API calls

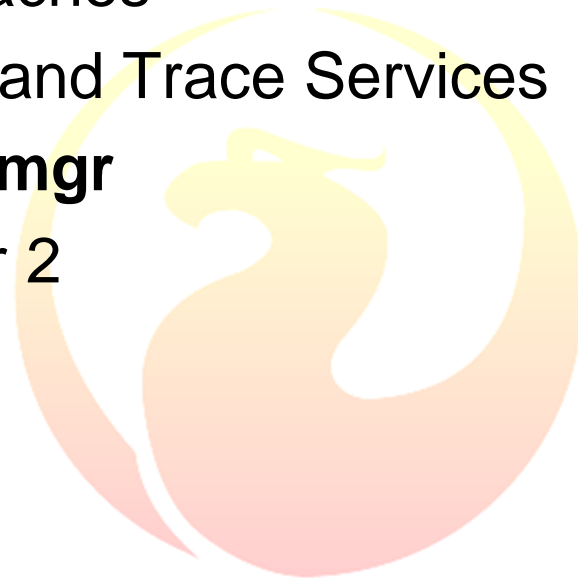
Action	Services API call
Start a new user trace session	isc_action_svc_trace_start
Stop a trace session	isc_action_svc_trace_stop
Suspend a trace session	isc_action_svc_trace_suspend
Resume a trace session	isc_action_svc_trace_resume
List all trace sessions	isc_action_svc_trace_list



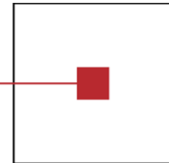
- Every user can start a trace session
- Used user name upon attaching to the services manager defines
  - Privileges in respect to managing other trace sessions
  - Visibility of traceable statements
- Privileges
  - SYSDBA can manage all other trace sessions including a system audit
  - Non-SYSDBA users can manage their own trace sessions only
- Visibility
  - A user trace session started by SYSDBA logs activities of all users/connections
  - A user trace session started by a non-SYSDBA user logs only its own activities



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# Usage of fbtracemgr



```
ca. C:\Windows\system32\cmd.exe - start_trace.bat

G:\DOKUMENT\Presentations\Firebird\Continuous Monitoring with the Trace API>"C:\Program Files\Firebird\Firebird_250_3051\bin"\fbtracemgr -se localhost/3051:service_mgr -user sysdba -password masterkey -start -name "User Trace 1" -config "tourism_trace.conf"
Trace session ID 4 started
2010-11-10T23:40:50.9430 (1368:0000000000F1ACD8) TRACE_INIT
    SESSION_4 User Trace 1

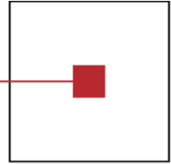
2010-11-10T23:40:50.9440 (1368:0000000000F1ACD8) START_TRANSACTION
    tourism.fdb (ATT_1415, TOURISM:NONE, NONE, TCPv4:127.0.0.1)
    C:\Program Files (x86)\Upscene Productions\Database Workbench 4 Pro\DBW4.exe:3768
    <TRA_24397, CONCURRENCY : NOWAIT : READ_WRITE>

2010-11-10T23:40:51.0720 (1368:0000000000F1ACD8) COMMIT_TRANSACTION
    tourism.fdb (ATT_1415, TOURISM:NONE, NONE, TCPv4:127.0.0.1)
    C:\Program Files (x86)\Upscene Productions\Database Workbench 4 Pro\DBW4.exe:3768
    <TRA_24397, CONCURRENCY : NOWAIT : READ_WRITE>
    0 ms, 1 read(s), 1 write(s), 1 fetch(es), 1 mark(s)

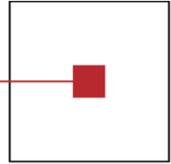
2010-11-10T23:40:51.0740 (1368:0000000000F1ACD8) START_TRANSACTION
    tourism.fdb (ATT_1415, TOURISM:NONE, NONE, TCPv4:127.0.0.1)
    C:\Program Files (x86)\Upscene Productions\Database Workbench 4 Pro\DBW4.exe:3768
    <TRA_24398, CONCURRENCY : NOWAIT : READ_WRITE>

2010-11-10T23:40:51.0790 (1368:0000000000F1ACD8) COMMIT_TRANSACTION
    tourism.fdb (ATT_1415, TOURISM:NONE, NONE, TCPv4:127.0.0.1)
    C:\Program Files (x86)\Upscene Productions\Database Workbench 4 Pro\DBW4.exe:3768
    <TRA_24398, CONCURRENCY : NOWAIT : READ_WRITE>
    0 ms, 1 read(s), 1 write(s), 1 fetch(es), 1 mark(s)
```

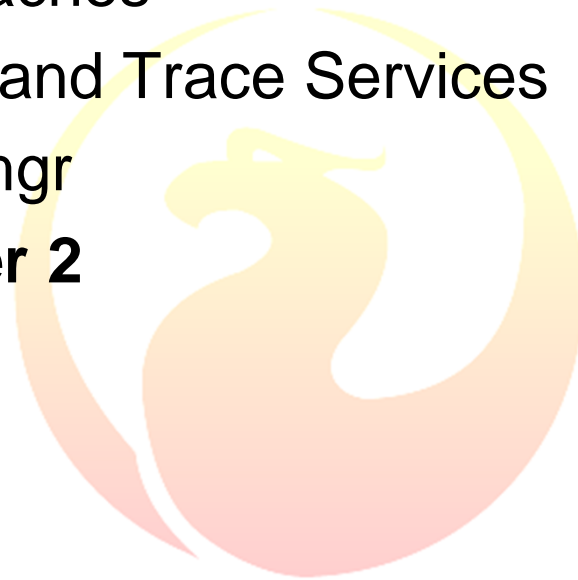
# Usage of fbtracemgr

A large, semi-transparent watermark of the Falcon logo is centered on the slide. The logo features a stylized falcon head in profile, facing right, set against a circular background with a yellow-to-orange gradient.

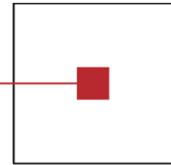
Live Demonstration



- Motivation
- Monitoring Approaches
- Firebird 2.5 Audit and Trace Services
- Usage of fbtracemgr
- **FB TraceManager 2**
- Q&A



# FB TraceManager 2



FB TraceManager 2 (Build: 2.0.0.7) - Enterprise Edition

Management Console

Connected Servers

localhost\_3051

prod\_3050

dev\_3050

qa\_3050

Trace Data Management

Import

Browse

Reporting

Analysis

Event Processing

Miscellaneous

Settings

Help

Connected Servers

localhost\_3051

List of trace sessions on server: localhost\_3051

#	SessionID	Timestamp	State	Type	Session Name	User
1	9	2011-10-31 09:12:23		Trace	FBTM - Tourism	SYSDBA

Registered Projects

#	ProjectID	Project Name	Session Name	Autostart	Log to Database	Commit interval	Disable Event Processing	Load Factor
1	2	Tourism	FBTM - Tourism	<input type="checkbox"/>	<input checked="" type="checkbox"/>	100	<input type="checkbox"/>	
2	4	Employee	FBTM - Employee	<input type="checkbox"/>	<input checked="" type="checkbox"/>	100	<input type="checkbox"/>	
3	3	Employee	FBTM - Employee	<input type="checkbox"/>	<input checked="" type="checkbox"/>	100	<input type="checkbox"/>	

Started Projects

Tourism (9)

Running ...

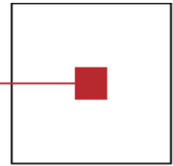
Raw Parsed Statistic Chart

Paused Font size 8 New event

```
1 Trace session ID 9 started
2 2011-10-31T09:12:31.3270 (3148:00000000035FB898) TRACE_INIT ...
3 2011-10-31T09:12:31.3300 (3148:00000000035FB898) START_TRANSACTION
4 tourism.fdb (ATT_1813, TOURISM:NONE, UNICODE_FSS, TCPv4:127.0.0.1)
5 C:\Program Files (x86)\Upscene Productions\Database Workbench 4 Pro\DW4.exe:5064
6 (TRA_50151, CONCURRENCY | NOWAIT | READ_WRITE)
7
8 2011-10-31T09:12:31.6740 (3148:00000000035FB898) PREPARE_STATEMENT ...
9
10
11 2011-10-31T09:12:31.6780 (3148:00000000035FB898) EXECUTE_STATEMENT_START
12 tourism.fdb (ATT_1813, TOURISM:NONE, UNICODE_FSS, TCPv4:127.0.0.1)
13 C:\Program Files (x86)\Upscene Productions\Database Workbench 4 Pro\DW4.exe:5064
14 (TRA_50151, CONCURRENCY | NOWAIT | READ_WRITE)
15
16
17 Statement 41:
18 -----
```

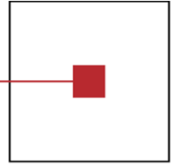
Database: localhost/3051:fbtm2\_installed.fdb Licensed to: Thomas Steinmaurer Edition: Enterprise Edition



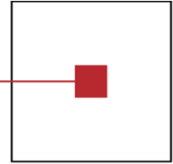


Live Demonstration

# FB TraceManager 2 Editions

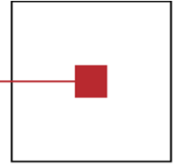


- Lite Edition
  - Local connections and raw trace data only
  - Freely available
- Standard Edition
  - Lite + Remote connections, Parser, Reporting
  - **99 EUR** per user named license
- Enterprise Edition
  - Standard + Analysis, Event Processing
  - **149 EUR** per user named license
- Trial Edition
  - 30 days limited Enterprise Edition
  - Limited number of received/parsed trace events



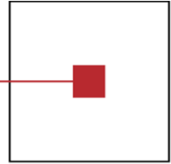
- Motivation
- Monitoring Approaches
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- Usage of fbtracemgr
- FB TraceManager 2
- **Q&A**



A large, stylized logo of a horse's head in profile, facing right. The logo is circular and has a gradient from yellow at the top to orange at the bottom. The text "Questions and Answers" is overlaid on the center of the logo.

# Questions and Answers

**The End**

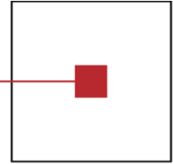


Thanks for your attention!

[thomas.steinmaurer@scch.at](mailto:thomas.steinmaurer@scch.at)

[t.steinmaurer@upscene.com](mailto:t.steinmaurer@upscene.com)

<http://blog.upscene.com/thomas>



- Firebird 2.5 Release Notes:  
<http://www.firebirdsql.org/devel/doc/rlsnotes/html/rlsnotes25.html>
- Trace Services and Audit in Firebird 2.5, by Vlad Khorsun; Firebird Conference 2009 Munich
- Audit and Trace Services in Firebird 2.5, by Thomas Steinmaurer, 2010:  
[http://www.ibphoenix.com/main.nfs?a=ibphoenix&page=ibp\\_audit\\_trace\\_steinmaurer](http://www.ibphoenix.com/main.nfs?a=ibphoenix&page=ibp_audit_trace_steinmaurer)
- FB TraceManager 2: <http://www.upscene.com/go/?go=fbtm>